

REMARKS

I. Introduction

In the Final Office Action, the Examiner rejected claims 1,2, 5-8, 11, 12, 14-22, and 25-30 under 35 U.S.C. §102(e) as being anticipated by Asakawa (U.S. Patent No. 6,135,809), and rejected claims 3, 4, 9, 10, 13, 23, and 24 under 35 U.S.C. §103(a) as being unpatentable over Asakawa in view of Horie (U.S. Patent No. 6,231,360). Applicants submitted a Request for Reconsideration on December 13, 2005. The Examiner responded via an Advisory Action dated January 3, 2006.

Applicants submit this Amendment along with a Request for Continued Examination and an Information Disclosure Statement. By this Amendment, Applicants have added new claims 31-33. Applicants respectfully traverse the rejections set forth in the Final Office Action, and submit that pending claims 1-33 are allowable over the applied references.

New claims 31-33 recite a card connector wherein "no portion of said base plate rests between said first and second side walls." These amendments find support, for example, in Figures 1 and 3-6.

II. Rejections of Claims in Office Action

Applicants respectfully traverse the rejection of claims 1,2, 5-8, 11, 12, 14-22, and 25-30 under 35 U.S.C. §102(e) as being anticipated by Asakawa. Asakawa fails to disclose a "second space defined by said first and second side walls," wherein "no portion of said base plate extends into said second space."

The Examiner acknowledges that Asakawa's partitions 28 constitute a part of Asakawa's base plate and that they "sit between the alleged first and second walls." In

the Advisory Action, however, the Examiner contends that, “the space of Asakawa is (at least partly) defined by the walls.” Applicants respectfully disagree.

Partitions 28 in Asakawa, which the Examiner acknowledge are parts of Asakawa’s base plate, see Final Office Action at 5, extend into a space between the alleged side walls. The Examiner points to two spaces, each sandwiched between this obstruction and a single side wall, and argues that they are “partly” defined by the side walls. Claims 1, 11, and 21, however, explicitly require a second space “defined by said first and second side walls.” Thus, both the first side wall and the second side wall must define any space meeting this claim limitation. The Examiner has not pointed to any such a space in Asakawa or the other cited references.

Thus, Askawa does not disclose the claimed second space, and independent claims 1, 11, and 21 are allowable over Asakawa for at least this reason. Moreover, Claims 2 and 5-8 are allowable at least due to their dependence from claim 1; claims 12 and 14-20 are allowable at least due to their dependence from claim 11; and claims 22 and 25-30 are allowable at least due to their dependence from claim 21.

Applicants respectfully traverse the rejection of claims 3, 4, 9, 10, 13, 23, and 24 as being unpatentable over Asakawa in view of Horie, and submit that neither Asakawa, Horie, nor the combination of these references teaches or suggests each and every element of these claims. In particular, Horie does not teach or suggest the claimed second space and base plate, and the Examiner does not rely on Horie for such teachings. Horie therefore fails to overcome the above-noted deficiencies of Asakawa. Accordingly, claims 3, 4, 9, 10, 13, 23, and 24 are allowable at least due to their corresponding dependence from claims 1, 11, and 21.

New claims 31-33 require a card connector “wherein no portion of said base plate extends into said second space between said first and second side walls.” As the Examiner has previously acknowledged, partitions 28 of Asakawa sit between the alleged side walls. Thus, Asakawa does not disclose all elements of claims 31-33. Horie fails to cure this deficiency of Asakawa. Claims 31-33 are therefore allowable over the applied references.

III. Patentability over Copending Applications and Patents Issued Therefrom

For the Office's convenience, Applicant identifies in Table 1 below certain copending applications and patents, including filing date, assignment, and inventor information. Applicant provides herewith Exhibit 1, which contains all of the claims of the listed applications and patents. Applicant submits these claims for the Office's convenience in evaluating any potential issues regarding statutory or obviousness-type double patenting.

Attorney Docket No.	U.S. Patent Application No.	U.S. Filing Date/ 371 (c) Date	First Named Inventor	Title	Assignment Recorded (Reel, Frame, Date)	Publication, Date
04208.0103-00000	09/840,109	April 24, 2001	Takeshi NISHIMURA	MULTI-CARD CARD CONNECTOR FOR MULTI-TYPE CARDS	Reel 011754, Frame 0468, on April 24, 2001	U.S. Patent No. 6,607,405 Dated: August 19, 2003
04208.0115-00000	09/890,637	October 12, 2001	Kiyoshi ABE	CARD CONNECTOR	Reel: 012244, Frame: 0230, on October 12, 2001	U.S. Patent No. 6,699,061 Dated: March 3, 2004

Attorney Docket No.	U.S. Patent Application No.	U.S. Filing Date/ 371 (c) Date	First Named Inventor	Title	Assignment Recorded (Reel, Frame, Date)	Publication Date
04208.0116-00000	09/922,866	August 7, 2001	Toshiyasu ITO	CARD EDGE CONNECTOR COMPRISING A HOUSING AND A PLURALITY OF CONTACTS	Reel: 012055, Frame: 0942, on August 7, 2001	U.S. Patent No. 6,645,012 November 11, 2003
04208.0133-00000	10/046,716	January 17, 2002	Masaaki OYA	CARD CONNECTOR	Reel: 012524, Frame: 0928, on January 17, 2002	U.S. Patent No. 6,685,512 Dated: February 3, 2004
04208.0137-00000	10/067,891	February 8, 2002	Toshiyasu ITO	CARD-EDGE CONNECTOR	Reel: 012867, Frame: 0153, on May 6, 2002	U.S. Patent No. 6,652,322 November 25, 2003
04208.0140-00000	10/090,800	March 6, 2002	Tetsuo TAKEYAMA	CONTACT TERMINAL AND CARD CONNECTOR HAVING THE SAME	Reel: 012977, Frame: 0513, on June 10, 2002	U.S. Patent No. 6,793,536 Dated: September 21, 2004
04208.0195-00000	10/721,424	November 26, 2003	Seiji SHISKURA	CARD CONNECTOR	Reel: 014751, Frame: 0534, on November 26, 2003	U.S. Patent No. 6,976,879 December 20, 2005
04208.0198-00000	10/807,312	March 24, 2004	Shigeru SATO	COMPOSITE TYPE CARD CONNECTOR	Reel: 015135, Frame: 0864, on March 24, 2004	U.S. Patent No. 6,863,571 March 8, 2005
04208.0208-00000	10/972,653	October 26, 2004	Minoru IGARASHI	IP CARD-CONNECTING ADAPTER	Reel: 015939, Frame: 0245, on October 26, 2004	U.S. Published Application No. US 2005-0088829 A1 Dated March 28, 2005

Attorney Docket No.	U.S. Patent Application No.	U.S. Filing Date/ 371 (c) Date	First Named Inventor	Title	Assignment Recorded (Reel, Frame, Date)	Publication, Date
04208. 0212- 0000	11/038,274	January 21, 2005	Osamu SHIMIZU	CARD CONNECTOR FOR AN ELECTRONIC DEVICE AND A CONTACT USED THEREIN	Reel: 016197, Frame: 0534, on January 21, 2005	U.S. Published Application No. US 2005- 0164559 A1 Dated: July 28, 2005

IV. Conclusion

In view of the foregoing amendments and remarks, Applicant respectfully requests reconsideration and reexamination of this application and the timely allowance of the pending claims.

Please grant any extensions of time required to enter this response and charge any additional required fees to our deposit account 06-0916.

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, L.L.P.

Dated: February 21, 2006

By: 

John M. Romary
Registration No. 26,331

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Exhibit 1:
Claims in Certain Copending Applications and Issued Patents

ISSUED CLAIMS

Application No. 09/840,109

Patent No. 6,607,405

Attorney Docket No. 04208.0103-00000

Filed April 24, 2001

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On both sides of the lower slot 25, on the other hand, guide grooves 31 for guiding attachment and detachment of the thin and wide type card 20 are formed. The thin and wide type card 20 is inserted along the guide grooves 31 in the state with the contact pad surface facing down.

As shown in FIG. 10 and FIG. 11, at the inside surface side of the housing lower plate 5, a plurality of grooves 51 are formed for positioning and pressing therein a plurality of contact terminals 50 for the thin and wide type card 20.

The respective contact terminals 50 for the thin and wide type card 20, as shown in FIGS. 8 and 9, comprise two types of long and short terminals, so that a short contact terminal is disposed between arrangement pitches of the long contact terminal. The respective contact terminals 50, as shown in FIG. 8, comprise cantilever contact springs. The contact terminals 50 have soldered portions 50a and 50a' (short one is indicated by ') soldered to the contact pads of the printed circuit board of the electronic appliance, fixing portions 50b and 50b' for fixing in the grooves 51, elastically deformable contact springs 50c and 50c', and contact portions 50d and 50d' protruding upward and contacting with the contact pads 23 of the thin and wide type card 20.

Further, the respective contact portions 50d and 50d' of the respective contact terminals 50 are arranged on two rows of straight lines E and F so as to correspond to the locations of the two rows of contact pads 23 of the thin and wide type card 20.

In making such arrangement, these contact terminals are disposed so that the contact portions 50a of some longer contact terminals where the soldered portions 50a thereof are positioned at the front surface side of the connector housing and the respective contact portions 50a' of some shorter contact terminals where the soldered portions 50a' are positioned at the rear surface side of the connector housing are positioned on one straight line E which extends in the card width direction. Further, these contact terminals are disposed so that the contact portions 50a of some longer contact terminals where the soldered portions 50a' thereof are positioned at the rear surface side of the connector housing and the respective contact portions 50a' of some shorter contact terminals where the soldered portions 50a' are positioned at the front surface side of the connector housing are positioned on the other straight line F which extends in the card width direction.

As described above, there are two types in the plurality of contact terminals 50 for the thin and wide type card 20 that one is of a type which is pressed into in the card detachment direction through the rear surface side of the connector housing 2, and another is of a type which is pressed into in the card insertion direction through the front surface side of the connector housing 2.

When the thin and wide type card 20 in the state with the contact pad surface facing down is inserted in the lower slot 25, the respective contact pads 23 of the thin and wide type card 20 contact with contact portions 50d and 50d' of the respective contact terminals 50.

Two contact terminals 52 for detecting the presence of a write protect pad 24 of the thin and wide type card 20 are provided on the housing lower plate 5.

As described above, in the present embodiment, the slots 15 and 25 for the two types of card are disposed at the upper and lower sides, and part of the contact terminals 50 for the thin and wide type card 20 composed of two types of long and short are in reverse in press-fit direction to the contact terminals for other than that part and for the narrow type card. Therefore, even if the slots 15 and 25 for these two

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types of cards 10 and 20 are disposed at the upper and lower sides, the respective soldered portions 40a and 50a of the respective contact terminals 40 and 50 are appropriately dispersed. Thereby, the soldered portions 40a and 50a of the contact terminals 40 and 50 for the two types of card do not interfere with each other, and the respective soldered portions 40a and 50a can be easily arranged in respective lines. Therefore, pressing into operation of the respective contact terminals becomes easy, image recognition of the soldered portions when the board is implemented and image inspection of the soldered portion become easy, and repair work using an electric soldering copper becomes easy.

Further, in the above embodiment, the respective contact terminals are arranged in opposition to each other so that contact parts 50d of the plurality of contact terminals of the two types of long and short are in line on the two straight lines E and F. Therefore, appropriate layout of the contact terminals corresponding to the specifications of the contact pads 23 of the thin and wide type card 20 can be easily achieved while reducing the packaging space of the connector.

Still further, in the above embodiment, the narrow type card 10 is inserted in the upper slot 15 and the thin and wide type card 20 in the lower slot 25, however, alternatively, this positional relation may be reversed.

Further, in the above embodiment, memory stick is used as an example of the narrow type card 10, and smart media as an example of the thin and wide type card 20, however, the present invention may be applied to any other types of card.

As described above, in the present invention, since the slots for the two types of card are disposed at the upper and lower sides, and part of the contact terminals for one card are disposed to be in reverse in press-fit direction to other contact terminals, the occupying area of the connector can be reduced, the soldered portions of the contact terminals for the two types of card do not interfere with each other, and the respective soldered portions can be easily arranged in respective lines. Therefore, pressing into operation of the respective contact terminals becomes easy, image recognition of the soldered portions when the board is implemented and image inspection of the soldered portion become easy, and repair work using an electric soldering copper becomes easy.

Yet further, since the respective contact portions of the plurality of contact terminals composed of two types of long and short are disposed in opposition to each other so that the contact portions are in line with two parallel lines extending in the card width direction, the connector packaging space can be reduced and appropriate layout of contact terminals corresponding to the contact pad layout of the predetermined cards can be easily achieved.

The present invention has been described in detail with respect to preferred embodiments, and it will now be apparent from the foregoing to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspect, and it is the intention; therefore, in the apparent claims to cover all such changes and modifications as fall within the true spirit of the invention.

What is claimed is:

1. A multi-card connector for multi-type cards capable of containing at least two types of first and second cards differing in outer shape and contact pad position, comprising:

a connector housing having an upper slot for containing said first card and a lower slot for containing said second card;

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a plurality of first contact terminals corresponding to contact pads for said first card; and

a plurality of second contact terminals corresponding to contact pads for said second card,

wherein each soldered portion of said first contact terminal is disposed at a rear surface side of said connector housing; and

for soldered portions of said second contact terminals, a first set thereof is disposed at the same rear surface side of soldered portions of said first contact terminals, and remnants thereof are all disposed at a front surface side of said connector housing so as to be in reverse direction to said first contact terminals.

2. A multi-card connector for multi-type cards capable of containing at least two types of first and second cards differing in outer shape and contact pad position, comprising:

a connector housing having an upper slot for containing said first card and a lower slot for containing said second card;

a plurality of first contact terminals corresponding to contact pads for said first card; and

a plurality of second contact terminals corresponding to contact pads for said second card,

wherein each soldered portion of said first contact terminal is disposed at a rear surface side of said connector housing;

for soldered portions of said second contact terminals, parts thereof are disposed at the same rear surface side of soldered portions of said first contact terminals, and remnants thereof are all disposed at a front surface side of said connector housing so as to be in reverse direction to said first contact terminals; and

wherein contact portions of said second contact terminals of which soldered portions are positioned at front surface side of said connector housing and contact portions of said second contact terminals of which soldered portions are positioned at a rear surface side are disposed almost on a straight line along a card width direction.

3. The multi-card card connector as claimed in claim 2, wherein said second contact terminals are formed of two types of long and short;

respective contact portions of long contact terminals of which soldered portions are positioned at a front surface side of said connector housing and short contact terminals of which soldered portions are positioned at a rear surface side of said connector housing are disposed on a first straight line extending in a card width direction; and

respective contact portions of short contact terminals of which soldered portions are positioned at a front surface side of said connector housing and long contact terminals of which soldered portions are positioned at a rear surface side of said connector housing are disposed on a second straight line extending in a card width direction.

4. A multi-card card connector for multi-type cards capable of containing at least two types of first and second cards differing in outer shape and contact pad position, comprising:

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a connector housing having a lower slot for containing said first card and an upper slot for containing said second card;

a plurality of first contact terminals corresponding to contact pads for said first card; and

a plurality of second contact terminals corresponding to contact pads for said second card,

wherein each soldered portion of said first contact terminal is disposed at a front surface side of said connector housing; and

for soldered portions of said second contact terminals, a first set thereof is disposed at the same front surface side of soldered portions of said first contact terminals, and remnants thereof are all disposed at a rear surface side of said connector housing so as to be in reverse direction to said first contact terminals.

5. A multi-card connector for multi-type cards capable of containing at least two types of first and second cards differing in outer shape and contact pad position, comprising:

a connector housing having a lower slot for containing said first card and an upper slot for containing said second card;

a plurality of first contact terminals corresponding to contact pads for said first card; and

a plurality of second contact terminals corresponding to contact pads for said second card,

wherein each soldered portion of said first contact terminal is disposed at a front surface side of said connector housing;

for soldered portions of said second contact terminals, parts thereof are disposed at the same front surface side of soldered portions of said first contact terminals, and remnants thereof are all disposed at a rear surface side of said connector housing so as to be in reverse direction to said first contact terminals; and

wherein contact portions of said second contact terminals of which soldered portions are positioned at front surface side of said connector housing and contact portions of said second contact terminals of which soldered portions are positioned at a rear surface side are disposed almost on a straight line along a card width direction.

6. A multi-card card connector as claimed in claim 5, wherein said second contact terminals are formed of two types of long and short;

respective contact portions of long contact terminals of which soldered portions are positioned at a front surface side of said connector housing and short contact terminals of which soldered portions are positioned at a rear surface side of said connector housing are disposed on a first straight line extending in a card width direction, and

respective contact portions of short contact terminals of which soldered portions are positioned at a front surface side of said connector housing and long contact terminals of which soldered portions are positioned at a rear surface side connector housing are disposed on a second straight line extending in a card width direction.

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ISSUED CLAIMS

Application No. 09/890,637

Patent No. 6,699,061

Attorney Docket No. 04208.0115-00000

Filed October 12, 2001

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upper body portion 21, i.e., the stepped portions 24, are supported and guided by the lower walls 17. The floating of the card 20 due to the elastic force of the contact terminals 40 is prevented by the side edge portions of the top surface of the upper body portion 21 being restricted by the upper walls 15 of the guide grooves 14a, 14b. The lower body portion 23 of the card 20 is accommodated in the space between the second side walls 18.

The card 20 can be inserted into the connector to a position where its cut-off corner portion 22 and front end wall engage with the corner wall 13 and the abutment wall 12, respectively. With the card 20 inserted to this position, the pair of ribs 50 formed on the base plate 31 of the housing 30 fit into the groove 26a of the card 20 adjoining the cut-off corner portion 22 of the card 20. At this time, the contact portion 40d of the contact terminal 40 projecting from between the paired ribs 50 is pressed and elastically deformed by the contact pad 27 provided in the groove 26a of the card 20, making elastic contact with the contact pad 27 with an appropriate contact pressure. Other contact terminals 40 not provided with the ribs 50 also engage with associated contact pads 27 with an appropriate contact pressure.

FIG. 7A and FIG. 7B show the card 20 wrongly inserted back to front into the connector.

In this case, too, the card 20 can be inserted into the connector with the upper body portion 21 supported by the guide grooves 14a, 14b. However, because the rear part of the card 20 is not formed with the grooves 26 as is the front part, if the card 20 is wrongly inserted back to front, the rear end wall 29 of the card 20 abuts against the front end face of the ribs 50 at some point on the way, blocking a further insertion of the card. Hence, with this connector, because the card 20 cannot be inserted any further as it can with the conventional connector, the contact terminals 40 can be prevented from being overloaded and displaced beyond its elastic limit.

In this embodiment, because the stopper structure formed by the pair of ribs 50 is provided, if the card is wrongly inserted back to front, it is possible to block the insertion of the card 20 before the contact terminals 40 are displaced in excess of their elastic limit, thus preventing plastic deformation of the contact terminals 40.

In the connector 1 of the embodiment above, because the cantilevered contact terminals 40 are arranged to have the terminal portion 40a on the front side of the connector 1 and the contact portion 40d on the rear side of the connector 1, the area occupied by the connector 1 can be made smaller than when their arrangements are reversed. That is, when the orientations of the contact terminals 40 are reversed from the above, the terminal portion 40a is exposed outside the housing of the connector 1 and the occupied area increases to that extent.

The ribs 50 can be made to function as the stopper as long as the ribs 50, when the card 20 is inserted, can fit into any one of the grooves 26 without hindering the contact between the contact terminals 40 and the contact pads 27. That is, the ribs 50 do not need to be provided in a pair on both sides of the contact terminal 40 as in the embodiment above but may be arranged to cover the contact terminal 40 from above (i.e., the ribs may cross the contact terminal 40).

But, providing the ribs 50 at the sides of the groove 32, in which the contact terminal 40 is press-fitted, as in the embodiment above has the advantage of facilitating the process of press-fitting the contact terminal 40 in the card insertion direction into the recessed portions 34 formed in

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the inner walls of the groove 32 because there is no hindrance above the contact terminal 40.

While in the embodiment above the ribs 50 are provided on both sides of the contact terminal 40, a rib 50 may be provided on one side only.

Further, although in the embodiment above the ribs 50 are provided adjoining the contact terminal 40 whose contact portion 40d is situated nearest to the front side of the connector (card insertion opening side) among the plurality of contact terminals 40 (in this case, a contact terminal 40 situated in front of the corner wall 13), they may be arranged to adjoin any other contact terminal 40. Alternatively, the ribs 50 may be provided at different positions adjoining a plurality of contact terminals 40.

While in the embodiment above, the ribs 50 are applied to the connector construction that supports both side edges of the upper body portion 21 of the card 20 by the guide grooves 14a, 14b formed in the connector housing 30, they can also be applied, with similar effects, to a connector construction that supports the bottom surface of the card 20, i.e., the lower body portion 23.

While in the embodiment above the top plate of the connector housing 30 covers only the guide grooves 14a, 14b, the abutment wall 12 and its vicinity, it may cover entire surface or most of the card.

Further, the connector housing may be constructed of a plurality of housing members, for example, an upper housing made from a worked metal plate and a lower housing made from resin.

In the embodiment above, because the card 20 is inserted with its contact pad arranged surface facing down, the contact terminals 40 are arranged on the base plate 31 of the connector housing 30. In a connector in which the card 20 is inserted with its contact pad arranged surface facing up, the contact terminals 40 may be arranged on the top plate of the connector housing 30. In such a connector, the pair of ribs 50 need to be provided on the top plate of the connector housing 30.

Further, while the embodiment above uses the connector for the SD card, the present invention can be applied to connectors for any card as long as the card is of a type that has a plurality of recessed portions 26 formed in its front part with contact pads 27 arranged at the bottoms of the recessed portions 26. For example, the present invention can also be applied to a connector designed for use with a card which has no stepped portions 24 at its side edges.

Industrial Applicability

As explained above, because the connector housing is provided with a raised portion which, when the card is inserted into the connector, fits into one of the recessed portions formed at the contact pad portions of the card, this raised portion works as a stopper when the card is wrongly inserted back to front. This stopper stops the card being inserted before the contact terminals are displaced in excess of their elastic limit. Thus, the plastic deformation of the contact terminals can be prevented reliably.

What is claimed is:

1. A card connector comprising:

a connector housing;

a plurality of contact terminals arranged in the connector housing and configured to engage a plurality of contact pads on a card; and

a raised portion formed in the connector housing such that the raised portion fits into one of a plurality of recessed

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portions of a properly inserted card, wherein the raised portion is a pair of ribs.

2. A card connector according to claim 1, wherein the raised portion is arranged adjacent to one of the contact terminals.

3. A card connector according to claim 1, wherein the connector housing has a plurality of grooves to rigidly secure and support the contact terminals and the raised portion is arranged in the connector housing adjacent to one of the grooves.

4. A card connector according to claim 1, wherein the raised portion is a pair of ribs, and one of the contact terminals is disposed within a space between the pair of ribs.

5. A card connector according to any one of claims 1 to 4, wherein the contact terminals are elastic leaf springs extending in a card insertion direction, and each of the elastic leaf springs has a terminal portion situated on a front side in the card insertion direction for electrical connection and a contact portion situated on a rear side for engagement with an associated contact pad.

6. A card connector according to any one of claims 1 to 4, wherein the raised portion is formed on a base plate of the connector housing.

7. A card connector according to claim 1, wherein the card has an upper body portion slightly narrower than the upper body portion and having the plurality of recessed portions; wherein the pair of guide grooves of the card connector are configured to support and guide both side edges of the upper body portion of the card as the card is inserted and retracted; and

wherein the connector housing has side walls defining a space to accommodate the lower body portion of the card below another space formed between the pair of guide grooves.

8. A card connector for holding a card having a plurality of recessed portions and a plurality of contact pads arranged in the recessed portions, the card connector comprising:

a connector housing;

a plurality of contact terminals arranged in the connector housing and configured to engage with the contact pads arranged in the recessed portions of a card;

a pair of guide grooves formed in the connector housing to support and guide both side edges of a card; and

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a raised portion formed in the connector housing such that the raised portion and at least one contact terminal fits into one of the recessed portions of a card when the card is normally inserted into the connector.

9. A card connector for holding a card having a plurality of recessed portions and a plurality of contact pads arranged in the recessed portions, the card connector comprising:

a connector housing;

a plurality of contact terminals arranged in the connector housing and configured to engage with the contact pads arranged in the recessed portions of a card, wherein the contact terminals are elastic leaf springs extending in a card insertion direction, and each of the elastic leaf springs has a terminal portion situated on a front side in the card insertion direction for electrical connection and a contact portion situated on a rear side for engagement with an associated contact pad;

a pair of guide grooves formed in the connector housing to support and guide both side edges of a card; and

a raised portion formed in the connector housing such that the raised portion fits into one of the recessed portions of a card when a card is normally inserted into the connector, wherein the raised portion is a pair of ribs, and one of the contact terminals is disposed within a space between the pair of ribs.

10. A card connector for holding a card having a plurality of recessed portions and a plurality of contact pads arranged in the recessed portions, the card connector comprising:

a connector housing;

a plurality of contact terminals arranged in the connector housing and configured to engage with the contact pads arranged in the recessed portions of a card;

a pair of guide grooves formed in the connector housing to support and guide both side edges of a card; and

a raised portion formed in the connector housing such that the raised portion fits into one of the recessed portions of a card when the card is normally inserted into the connector, wherein the raised portion is formed on a base plate of the connector housing and comprises a pair of ribs, and one of the contact terminals is disposed within a space between the pair of ribs.

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ISSUED CLAIMS

Application No. 09/922,866

Patent No. 6,645,012

Attorney Docket No. 04208.0116-00000

Filed August 7, 2001

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As a result, the contact portions 20d of the contacts 20 are pressed against the corresponding contact pads 3, 4 of the card type circuit board 1, thereby establishing an electrical connection between them.

A temperature rise of the contacts depends on ohmic resistance of the contacts and decreases as the resistance is lower. The ohmic resistance of the contact is determined by a conductivity dependent on material of the contact, and by a cross-sectional area of a portion where the electric current flows. If the same material is used, the larger the cross-sectional area, the lower the resistance.

There is a contact resistance in that part of the contact 20 which engages the contact pad 3, 4 of the card type circuit board 1, i.e., the contact portion 20d. The contact resistance is determined by an area of the contact portion 20d that is actually in contact with the contact pad 3, 4. A temperature rise decreases as the contact area increases. The size of the contact area depends on the width and the number of the contact portions. The greater the width of the contact portion and the number of contacting locations, the smaller the temperature rise of the contact 20 will be.

It is rare that the contact portion 20d and the surface of the contact pad of the card type circuit board 1 are perfectly parallel.

The contact area might be reduced even though the width of the contact portion becomes wider if only one part of the contact portion in the direction of the width engages the contact pad surface. To deal with this situation, this embodiment divides widthwise the spring portion of each of the contact pieces 201, 202, 203 into a plurality of spring portions. That is, the divided spring portions, when the card type circuit board 1 is inserted, can twist or deform because of their elasticity according to the flatness or coplanarity of the surface of the pad, thus assuring that the contact portions of all the spring portions reliably engage the contact pad surface.

Although in this embodiment a plurality of contact pieces are stacked together to form the contact 20, it is possible to use a single contact piece to form a contact 301 having a fixed portion 301a, a connecting portion 301b, and a spring portion 301c divided into a plurality of spring portions each having a contact portion 301d so that the contact portions 301d are scatteringly or dispersedly allocated in the mating contact pad in the directions of the width and the length of the contact, as shown in FIG. 13. With this construction, the number of contact portions in contact with the corresponding contact pad can be increased compared with the conventional contact, thus reducing contact resistance and minimizing a temperature rise of the contact.

Further, while the above embodiment takes as an example a card edge connector for use with a card type circuit board having contact pads arranged on both of its surfaces, the present invention can also be applied to a connector for a card type circuit board having the contact pads on only one of its surfaces.

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The present invention has been described in detail with respect to preferred embodiments, and it will now be apparent from the foregoing to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and it is the intention, therefore, in the appended claims to cover all such changes and modifications as fall within the true spirit of the invention.

What is claimed is:

1. A card edge connector electrically connecting to a card type circuit board, wherein the card type circuit board has a plurality of contact pads arrayed on at least one of surfaces of an edge portion thereof, the card edge connector comprising:

a housing having a slot into which the card type circuit board is inserted; and

a plurality of contacts, each comprising a plurality of stacked contact pieces, each of the stacked contact pieces having a fixed portion to be fixed in the housing, a connecting portion extending from the fixed portion in one direction, a spring portion extending from the fixed portion in another direction and being elastically displaceable, and a contact portion at a free end of the spring portion;

wherein the contact portions of the plurality of contact pieces are allocated in the direction of the length of the contact within a size of the corresponding contact pad.

2. The card edge connector according to claim 1, wherein the fixed portion, the spring portion and the contact portion of each of the stacked contact pieces are almost equal in width.

3. The card edge connector according to claim 2, wherein the fixed portions of the plurality of stacked contact pieces are press-fitted and securely held in each of grooves formed in the housing.

4. The card edge connector according to claim 1, wherein the spring portion and the contact portion of each of the stacked contact pieces are divided into a plurality of parts in the direction of the width of the contact.

5. The card edge connector according to claim 4, wherein the fixed portions of the plurality of stacked contact pieces are press-fitted and securely held in each of grooves formed in the housing.

6. The card edge connector according to claim 1, wherein the connecting portions of the plurality of contact pieces are shifted in the direction of the width of the contact so that the connecting portions do not overlap.

7. The card edge connector according to claim 6, wherein the fixed portions of the plurality of stacked contact pieces are press-fitted and securely held in each of grooves formed in the housing.

8. The card edge connector according to claim 1, wherein the fixed portions of the plurality of stacked contact pieces are press-fitted and securely held in each of grooves formed in the housing.

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ISSUED CLAIMS

Application No. 10/046,716

Patent No. 6,685,512

Attorney Docket No. 04208.0133-00000

Filed January 17, 2002

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piece unit 43a is bent at the boundary e1 between the fixing section 42 and the unit. While, the right spring piece unit 43b is bent at a section e2 apart from the fixing section 42 toward the distal end.

The relief hole 9 formed in the bottom plate 4 of the lower housing 10 at a position beneath the respective contact terminal 40 has a shape capable of achieving the same function as in the first embodiment shown in FIG. 1. That is, as shown in FIGS. 7, 8 and 11, the relief hole 9 in this embodiment is asymmetrically formed as seen in the right and left directions so that at least a portion of the respective spring piece unit 43a, 43b closer to the side of the fixing section 42 from the bending position e1, e2 is pushed to be in contact with bottom plate 4 of the housing. There is no bottom plate 4 beneath the left spring piece unit 43a.

On the other hand, for the right spring piece unit 43b, the relief hole 9 is formed so that the bottom plate 4 of the housing exists beneath the non-bending portion 46 between the bending section e2 and the fixing section 42 to function as a part 4a to be pressed the non-bending portion 46 of the right spring piece unit 43b.

As described above, in the third embodiment, since the length, the width, the shape and the bending position are different between both the split spring piece units 43a, 43b, and in addition, part of the split spring piece unit 43b closer to the proximal end thereof is capable of being pressed onto the bottom plate 4, both the spring piece units 43a, 43b are different from each other in a mass, a spring constant or a contact force (contact pressure) whereby it is possible to differentiate the resonance frequency (natural frequency) of the spring piece units 43a, 43b. Accordingly, it is possible to prevent the instantaneous electric break due to the impact or vibration from occurring between the contact terminal and the contact pad of the card as well as to readily obtain a proper contact pressure between the contact terminal and the contact pad of the card.

In this regard, when differentiating the contact pressure on the contact point sections 44 of both the spring piece units 43a, 43b from each other, the contact pressure on the contact point section of the one spring piece unit is preferably $\frac{1}{3}$ to $\frac{4}{3}$ of the contact pressure of the other.
(Modified Embodiment)

According to the present invention, the contact terminal 40 may be split into any number of spring piece units, including three or more. Also, any means may be adopted other than described above to change a mass and a spring constant of the respective split spring piece unit. For instance, the plating material for the split spring piece unit may be changed. Other means may be used for varying the contact force of the contact point section of the split spring piece unit.

In the above embodiments, while the present invention is applied to the contact terminal 40 of a type in which the spring piece section 43 extends in one direction, it may be applied to other types of the contact terminal, for example, in which the spring piece section 43 has a turn-up portion in the midway thereof.

The contact forces of the contact point sections of the respective spring piece units may be changed by varying the bending angles of the spring piece sections relative to the fixing section 42 when no load is applied, so that amounts of the elastic deformation of the contact point section in the spring piece units are different from each other when the card 20 is loaded. Further, other means may be used for changing the contact force. For instance, while the bending angles of the split spring piece units 43a, 43b relative to the fixing section are equal to each other, different materials

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and/or thicknesses may be adopted for forming the split spring piece units 43a, 43b so that values of the spring constant thereof are different and thereby the contact forces are different from each other.

While the explanation is made on the SD card as a representative example of the IC card 20 in the above embodiments, the present invention may be applicable to a card connector for any other IC cards such as SIM card, MMC card (a trade mark), SMART-MEDIA CARD (a trade mark) or MEMORY STICK (a trade mark). In such a case, a structure of the card connector therefor may be optional provided it matches with the card.

The present invention has been described in detail with respect to preferred embodiments, and it will now be apparent from the foregoing to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspect, and it is the intention, therefore, in the apparent claims to cover all such changes and modifications as fall within the true spirit of the invention.

What is claimed is:

1. A card connector a plurality of contact terminals, each having a terminal section to be connected to a printed circuit board, a fixing section to be secured to a connector housing and a spring piece section having a contact point section at a distal end thereof and bent to be elastically deformable, for holding an IC card, within said connector housing so that, when said IC card is loaded therein, a plurality of contact pads of said IC card are brought into contact with said contact point sections of said plurality of contact terminals, respectively, arranged in said connector housing,

wherein said spring piece section of said contact terminals is split into at least a first and a second spring piece unit, each of said split spring piece units having a bending section provided proximal to said fixing section, said bending section of said second spring piece unit not coinciding with said bending section of said second spring piece unit, said first spring piece unit of each spring piece section having a different width than the width of said second spring piece unit of the same spring piece section.

2. A card connector as defined in claim 1, wherein said pressed portion is disposed on a top plate or bottom plate of said connector housing.

3. A card connector as defined in claim 1, wherein a width of said contact point section in some of said spring piece units is larger than a width of said spring piece section.

4. A card connector as defined in claim 1, including a surface in said connector housing against which is pressed a portion of at least one of said spring piece units, extending to a side of said fixing section from said bending section.

5. A card connector as defined in claim 1, wherein in each of said split spring piece units, at least one of a mass, a spring constant and a contact force with said contact pad of said card is different from those of the other split spring piece units.

6. A card connector as defined in claim 5, wherein a length of each said split spring piece unit is different from that of the other.

7. A card connector as defined in claim 5, wherein a bending angle of said spring piece section relative to said fixing section in each said split spring piece unit without a load is different of that of the other.

8. A card connector comprising a plurality of contact terminals, each having a terminal section to be connected to a printed circuit board, a fixing section to be secured to a connector housing and a spring piece section having a

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contact point section at a distal end thereof and bent to be elastically deformable, for holding an IC card within said connector housing so that, when said IC card is loaded therein, a plurality of contact pads are brought into contact with said contact point sections of the plurality of contact terminals, respectively, arranged in said connector housing,

wherein said spring piece section of said contact terminal is split into a plurality of spring piece units, each said split spring piece unit bending so that a bending section is located by a side of said distal end thereof from said fixing portion in said split spring piece unit, and

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a surface in said connector housing against which is pressed a portion of one of the plurality of spring piece units extending to said fixing section from said bending section in said spring piece unit, and a portion of the other spring piece unit extending to said fixing section from said bending section is in a free state.

9. A card connector as defined in claim 8, wherein said pressed portion is disposed on a top plate or bottom plate of said connector housing.

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ISSUED CLAIMS

Application No. 10/067,891

Patent No. 6,652,322

Attorney Docket No. 04208.0137-00000

Filed February 8, 2002

concerned, when the three contact units 201, 202 and 203 are stacked with each other, flat surfaces of the terminal sections 20b, 202b and 203b of the contact units 201, 202 and 203 are arranged side by side at a generally equal height (flush with each other in a common plane) as shown in FIGS. 8, 9 and 10.

That is, the respective terminal sections 20b, 202b and 203b of the plurality of contact units 201 to 203 are arranged to be shifted in the widthwise direction of the contact terminal 20.

This is because of the following reasons. Since a distance from the fixed part 20a of the contact unit 201 to the terminal section 20b to be soldered is short, the terminal sections 20b, 202b and 203b are arranged flush with each other in a common plane to facilitate the soldering operation.

Also, in this embodiment, since the fixed parts of the three contact units 201, 202 and 203 have a generally equal width, these contact units 201, 202 and 203 can be press-fit altogether into the above-mentioned groove of the connector housing.

According to such a card-edge connector, the card edge section 2 of the edge board 1 can be positioned at an open end of the recess 12 of the inner housing 11b via the slit 11s of the outer housing 11a, and the edge board 1 is inserted into the recess 12 until the distal end of the card edge section 2 reaches the bottom surface of the recess 12 (and touches to the bottom plate member 13) while pressing the pair of contact terminals 20 away from each other as shown in FIG. 7.

Thereby, the pair of contact terminals 20 bends so that the contact point sections 201d, 202d and 203d of the pair are distant from each other. Thus, the contact point sections 201d, 202d and 203d are brought into press-contact with the contact pads 3 and 4, resulting in the electric connection between the both.

In this regard, since the temperature rise in the contact terminal 20 is decided by the conductor resistance of the contact terminal 20, the smaller the resistance, the less the temperature rise. The conductor resistance of the contact terminal 20 is decided by a dielectric constant inherent to material of the contact terminal 20 and a cross-sectional area of a portion through which an electric current flows. If the material is identical, the larger the cross-sectional area, the smaller the conductor resistance of the contact terminal 20.

Accordingly, in this embodiment, the plurality of contact units 201, 202 and 203 are stacked with each other to configure the contact terminal 20 having a larger cross-sectional area. As a result, the temperature rise of the contact terminal 20 is restricted when the edge board 1 is inserted into the connector to operate.

On the other hand, a contact resistance generates at a position at which the contact terminal 20 is brought into contact with the contact pad 3 or 4 of the edge board 1; i.e., the contact point section. The contact resistance is decided by an area of the contact point section in contact with the contact pad 3, 4, and the larger the contact area, the less the temperature rise. The size of the contact area is decided by a width of the respective contact point section and the number of the contact point sections, and the wider the width and the more the number, the less the temperature rise of the contact terminal 20.

In this embodiment, since the contact terminal 20 is constituted so that the contact point sections 201d, 202d and 203d of the respective contact units 201, 202 and 203 are shifted to each other at a predetermined distance within the contact pad 3 or 4 in the lengthwise direction of the contact

terminal 20, it is possible to increase the number of contact point sections in the contact terminal 20, whereby the contact resistance becomes smaller to suppress the temperature rise of the contact terminal 20.

In this regard, there may be a case wherein the contact area decreases even if the width of the contact point section is merely widened, since it is a rare case that the contact point section of the contact of the contact terminal 20 and the pad surface of the edge board 1 are completely parallel to each other and only part of the contact point section in the widthwise direction is brought into contact with the pad. To avoid such an inconvenience, according to this embodiment, the spring piece section of the contact unit 201, 202, 203 is split into a plurality of spring piece units in the widthwise direction.

That is, since the split spring piece units are deformable in a distorted manner due to the elasticity of the spring piece section when the edge board 1 is inserted, it is possible to assuredly bring the contact point sections of all the spring piece units into contact with the contact pads of the edge board 1.

Also, in this embodiment, since the distal end 201e of the innermost contact unit 201 described above extends to a position at which it is not entangled with the distal end of the adjacent contact unit 202, it is possible to assuredly prevent the distal end of the contact unit 201 from entangling with the distal end of the contact unit 202 when the respective contact units are elastically deformed or restored. Thus, it is possible to assuredly avoid the inferior contact of the contact unit to result in the expected effect due to the contact terminal having multi-contact points.

In this regard, while the contact terminal 20 is constituted by stacking a plurality of contact units with each other in the above embodiment, a contact terminal may be merely constituted by a single spring piece not being stacked but split into a plurality of spring piece units so that contact point sections are distributed to disperse in the widthwise and lengthwise directions within the contact pad. According to this structure, the number of contact point sections to be in contact with the contact pad increases in comparison with the prior art, whereby the contact resistance becomes smaller and the temperature rise in the contact terminal can be restricted.

Also, while the explanation has been made of the card-edge connector for the edge board having the contact pads on both sides thereof, the present invention may be applied to a connector for an edge board having contact pads solely on one side thereof.

The present invention has been described in detail with respect to preferred embodiments, and it will now be apparent from the foregoing to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and it is the intention, therefore, in the appended claims to cover all such changes and modifications as fall within the true spirit of the invention.

What is claimed is:

1. A card-edge connector for electrically connecting to a printed circuit board having a plurality of contact pads arranged on at least one side of an end portion of the printed circuit board, comprising:

a connector housing having a recess into which the end portion of the printed circuit board is to be inserted, and a plurality of contact terminals, wherein each contact terminal is formed of a plurality of contact units wherein the contact units are stacked and wherein each

contact unit comprises a fixed part to be secured to said connector housing and an elastically deformable spring piece section extending from said fixed part and having a contact point section at a distal end thereof to contact with at least one contact pad on said printed circuit board when said end portion of said printed circuit board is inserted into said card-edge connector, wherein:

said plurality of stacked contact units are configured so that the contact point sections are distributed to disperse in the lengthwise direction of said corresponding contact terminal,

each spring piece section of said plurality of stacked contact units, except the spring piece section of an innermost contact unit, comprises a fold at a midpoint thereby extending the spring piece section back toward the contact point section of the innermost contact unit and forming a hook-shape,

the contact point section of said innermost contact unit is formed to be arcuate-shape, and

a distal end of said innermost contact unit extends to a position at which it is not entangled with a distal end of an adjacent contact unit.

2. A card-edge connector as defined in claim 1, wherein each contact point section of said plurality of stacked contact units, except the contact point section of said innermost contact unit, is bent.

3. A card-edge connector as defined in claim 1, wherein each spring piece section of said plurality of stacked contact units comprises a plurality of spring piece units disposed in widthwise direction of said corresponding contact terminal.

4. A card-edge connector for electrically connecting to an edge board comprising a connecting section having a first group and a second group of electrode pads formed respectively on a first side and a second side of said connecting section, the card-edge connector comprising:

a housing portion for accommodating the connecting section of the edge board;

a positioning section for positioning said connecting section of said edge board in said housing portion so that said first and second groups of electrode pads are disposed in a predetermined direction;

a plurality of contact terminals arranged within said housing portion along said predetermined direction to electrically connect with said first and second groups of electrode pads of said edge board;

wherein said contact terminals comprise:

a plurality of first contact terminals, each first contact terminal having a plurality of contact point groups formed in substantially a same plane and arranged in a direction generally orthogonal to said predetermined direction of said first group of electrode pads, wherein the contact point groups of each first contact terminal are configured to be in contact with different positions of a corresponding electrode pad in said first group, and

a plurality of second contact terminals arranged opposite to said plurality of first contact terminals at a predetermined distance, respectively, each second contact terminal having a plurality of contact point groups formed in substantially a same plane and arranged in a direction generally orthogonal to said predetermined direction of said second group of electrode pads, wherein the contact point groups of each second contact terminal are configured to be in contact with different positions of a corresponding electrode pad in said second group, and

wherein each of the plurality of contact point groups of the first and second contact terminals is disposed at a distal end of a plurality of spring piece units joined with each other at one end and separated from each other at another end to be individually deformable.

5. A card-edge connector as defined in claim 4, wherein: each of said first and second contact terminals comprises a plurality of terminal portions formed substantially in a same plane to be electrically connected by soldering, and

each terminal portion is coupled to one end of a corresponding fixed portion and wherein another end of the corresponding fixed portion is coupled to a corresponding plurality of spring piece units.

6. A card-edge connector as defined in claim 4, wherein said connecting section of said edge board is nipped by the plurality of contact point sections in said first and second contact terminals.

7. A card-edge connector as defined in claim 4, wherein said positioning section is formed by a recess in an interior of said housing portion for holding and guiding said edge board and a bottom plate member to which an end of said connecting section of said edge board is brought into contact.

8. A card-edge connector for electrically connecting to a printed circuit board having a plurality of contact pads arranged on at least one side of an end portion of the printed circuit, comprising:

a connector housing having a recess into which the end portion of the printed circuit board is to be inserted, and

a plurality of first contact terminals, wherein each first contact terminal is formed of a plurality of first contact units wherein the first contact units are stacked and wherein each first contact unit comprises a fixed part to be secured to said connector housing and an elastically deformable spring piece section extending from said fixed part and having a contact point section at a distal end thereof to contact with at least one contact pad on said printed circuit board when said end portion of said printed circuit board is inserted into said card-edge connector, wherein:

said plurality of stacked first contact units are configured so that the contact point sections are distributed to disperse in the lengthwise direction of said corresponding first contact terminal, and

wherein each spring piece section of said plurality of stacked first contact units comprises a plurality of spring piece units disposed in a widthwise direction of said corresponding first contact terminal.

9. A card-edge connector as defined in claim 8, wherein each spring piece section of said plurality of stacked first contact units, except the spring piece section of an innermost first contact unit, comprises a fold at a midpoint thereby extending the spring piece section back toward the contact point section of the innermost first contact unit and forming a hook-shape.

10. A card-edge connector as defined in claim 9, wherein the contact point section of said innermost first contact unit is formed to be arcuate-shape.

11. A card-edge connector as defined in claim 9, wherein a distal end of said innermost first contact unit extends to a position at which it is not entangled with a distal end of an adjacent first contact unit.

12. A card-edge connector as defined in claim 9, wherein each contact point section of said plurality of stacked first contact units, except the contact point section of said innermost first contact unit is bent.

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13. A card-edge connector as defined in claim 8, wherein the printed circuit board comprises a plurality of contact pads arranged on a first side and a second side of an end portion of the printed circuit and wherein each contact point section of said plurality of stacked first contact units makes contact with at least one contact pad on said first side of said printed circuit board when said end portion of said printed circuit board is inserted into said card-edge connector, the card-edge connector further comprising:

a plurality of second contact terminals, wherein each second contact terminal is formed of a plurality of second contact units, wherein the second contact units are stacked, and wherein each second contact unit comprises a fixed part to be secured to said connector housing and an elastically deformable spring piece section extending from said fixed part and having a

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contact point section at a distal end thereof to make contact with at least one contact pad on said second side of said printed circuit board when said end portion of said printed circuit board is inserted into said card-edge connector, wherein:

said plurality of stacked second contact units are configured so that the contact point sections are distributed to disperse in the lengthwise direction of said corresponding second contact terminal, and wherein each spring piece section of said plurality of stacked second contact units comprises a plurality of spring piece units disposed in a widthwise direction of said corresponding second contact terminal.

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ISSUED CLAIMS

Application No. 10/090,800

Patent No. 6,793,536

Attorney Docket No. 04208.0140-00000

Filed March 6, 2002

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the contact terminal 2 is press-fit into the groove 10s in the inserting direction of the elongate type memory card 6 indicated by an arrow IN in FIG. 6.

As illustrated in FIGS. 7A, 7B, 8A and 8B in an enlarged scale, the groove 10s consists of a portion for holding a flat surface contiguous to the cable connecting section 2C of the contact terminal 2, and a portion for holding the card connecting section 2A. In this regard, in FIGS. 7A, 7B, 8A and 8B, a state is illustrated wherein the elongate type memory card 6 is accommodated in the accommodation portion 24. Every adjacent grooves 10s are partitioned by a wall.

The portion for holding the flat surface contiguous to the cable connecting section 2C of the contact terminal 2 in the respective groove 10s passes through the interior of the cable connecting section 10C.

As shown in FIGS. 9 and 10, the cable connecting section 10C of the housing member 10 has an insertion slot 10J for allowing the insertion of a portion of the flexible flat cable 8 in which are provided the electrode pads 8a while being in register. The insertion slot 10J has a width in correspondence to that of the flexible flat cable 8, and is formed corresponding to a position aligned with a gap defined between the bifurcate forks 2ka and 2kb in the clip portion 2K of the contact terminal 2 to be held.

In FIGS. 8A and 8B, a depth L of the insertion slot 10J is determined so that the electrode pad 8a is brought into contact with the contact point 2e when the flexible flat cable 8 is inserted until the distal end thereof touches the closed end of the insertion slot 10J.

Further, the insertion slot 10J is generally orthogonal to a part of the contact terminal 2 for holding the flat surface contiguous to the cable connecting section 2C of the contact terminal 2 in the respective groove 10s.

Accordingly, as shown in FIG. 9 by a chain double-dashed line, when a part of the flexible flat cable 8 in which the electrode pads 8a are provided is inserted into a gap between the bifurcate forks 2ka and 2kb in the clip portion 2K of the contact terminal 2 via the insertion slot 10J, the respective electrode pad 8a is automatically electrically connected to the contact terminal 2.

As a result, it is possible to ensure the electric connection of the respective contact terminal 2 of the card connector with the electrode pad 8a of the flexible flat cable 8 without the necessity of a wiring board having a conductive layer formed therein.

The present invention has been described in detail with respect to preferred embodiments, and it will now be apparent from the foregoing to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspect, and it is the intention, therefore, in the apparent claims to cover all such changes and modifications as fall within the true spirit of the invention.

What is claimed is:

1. A contact terminal comprising:

- a first connecting section for electrically connecting with an electrode pad of a cable by pinching said electrode pad between a plurality of forks in said first connecting section, said first connecting section being formed at one side of said contact terminal, and
- a second connecting section for electrically connecting with an electrode of a card by contacting a single side of said card, said second connecting section being formed at a second side of said contact terminal, continuous with said first connecting section.

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2. A contact terminal as defined in claim 1, wherein a coupling section for coupling said first connecting section to said second connecting section is provided between said first and second connecting sections.

3. A contact terminal as defined in claim 2, wherein said coupling section has coupling surfaces orthogonal to each other and coupled to said first and second connecting sections, respectively.

4. A card connector having contact terminals, comprising:

- a plurality of contact terminals, each having a first connecting section for electrically connecting with an electrode pad of a cable by pinching said electrode pad between a plurality of forks in said first connecting section, said first connecting section being formed at one side of said contact terminal and a second connecting section for electrically connecting with an electrode of a card by contacting a single side of said card, said second connecting section being formed at a second side of said contact terminal, continuous with said first connecting section,

a card accommodation portion in which said second connecting sections of said contact terminals are disposed, for accommodating said card; and

a cable connecting section in which said first connecting sections of said contact terminals are disposed, having an insertion slot for allowing said electrode pad of said cable to be inserted.

5. A card connector having contact terminals as defined in claim 4, wherein a coupling section for coupling said first connecting section to said second connecting section is provided between said first and second connecting sections.

6. A card connector having contact terminals as defined in claim 5, wherein said coupling section of said contact terminal is held in a groove formed in said card connector, adjacent to said card accommodation portion and said cable connecting section.

7. A card connector having contact terminals as defined in claim 6, wherein said coupling section of said contact terminal is inserted into said groove in a card inserting direction.

8. A card connector having contact terminals as defined in claim 4, wherein said card is removably accommodated in said card accommodation portion.

9. A card connector having contact terminals as defined in claim 4, wherein a plurality of contact terminals are provided in correspondence to a plurality of electrodes in said card accommodated in said card accommodation portion.

10. A card connector having contact terminals as defined in claim 4, wherein said card is an elongate type memory card.

11. A contact terminal comprising:

- a first connecting section for electrically connecting with a terminal of a cable while pinching said terminal, said first connecting section being formed at a first side of said contact terminal;
- a second connecting section for electrically connecting with an electrode of a card while being in contact with said electrode, said second connecting section being formed at a second side of said contact terminal; and
- a coupling section for coupling said first connecting section to said second connecting section, wherein: said coupling section is provided between said first and second connecting sections; and said coupling section is configured to permit insertion of said first connection section into a groove of a card accommodation member in a same direction that the card may be inserted into said member,

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whereby, said coupling section may extend in said groove from a first opening in said member into which said terminal of said cable may be inserted to contact said first connecting section to a second

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opening in said member into which said card may be inserted to contact said second connecting section.

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ISSUED CLAIMS

Application No. 10/721,424

Patent No. 6,976,879

Attorney Docket No. 04208.0195-00000

Filed November 26, 2003

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and modifications may be made without departing from the invention in its broader aspect, and it is the intention, therefore, in the apparent claims to cover all such changes and modifications as fall within the true spirit of the invention.

What is claimed is:

1. A card connector comprising:
a housing;
a card insertion opening formed by opening at least one end of the housing; and
a plurality of contacts arranged in the housing; and
a switching mechanism comprising an actuator member and a shutter member,
wherein said shutter member is selectively movable between a first position and a second position, the card connector receiving a first card having a first size when the shutter member moves to the first position, and the card connector receiving a second card having a second size when the shutter member moves to the second position.
2. A card connector according to claim 1, wherein the actuator member is movably arranged near the card insertion opening and removably interlocked with the shutter member.
3. A card connector according to claim 1, wherein the actuator member is a first actuator member, and is pivotally arranged on a first side of the card insertion opening, the card connector further comprising:
a second actuator member pivotally arranged on a second side of the card insertion opening,
wherein the first and second actuator members are configured to removably interlock with the shutter member.
4. A card connector according to claim 1, wherein the actuator member is a switching member at the card insertion opening.
5. A card connector according to claim 1, wherein the shutter member has a shutter plate and is latched by the actuator member through latch engagement on a side of the shutter plate.
6. A card connector according to claim 1, wherein the shutter member is pivotally arranged to open and close the card insertion opening.
7. A card connector according to claim 1, wherein the actuator member is formed by bending an elongate metal strip, the elongate metal strip being elastically deformable, and the actuator member being mounted at the card insertion opening.
8. A card connector according to claim 7, wherein the elongate metal strip is provided with a cam portion at a bent inner corner, which engages a card.

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9. A card connector according to claim 1, wherein the actuator member has a cam surface that changes an inlet area of the card insertion opening.

10. A card connector according to claim 9, wherein the cam surface of the actuator member is a vertical surface.

11. A card connector

comprising:

a housing;

a card insertion opening formed by opening at least one end of the housing; and

a plurality of contacts arranged in the housing, wherein a switching mechanism comprising an actuator member and a shutter member is provided in the housing,

the actuator member has a cam surface that changes an inlet area of the card insertion opening, and

the cam surface of the actuator member is downwardly and divergently inclined to situate inwardly at its upper portion.

12. A card connector

comprising:

a housing;

a card insertion opening formed by opening at least one end of the housing; and

a plurality of contacts arranged in the housing, wherein a switching mechanism comprising an actuator member and a shutter member is provided in the housing,

the actuator member has a cam surface that changes an inlet area of the card insertion opening, and

the cam surface of the actuator member has an inwardly bulged portion formed at a top part thereof.

13. A card connector according to claim 1, wherein the shutter member is rearwardly pivotally arranged to open and close the card insertion opening.

14. A card connector comprising:

a housing including a card insertion opening formed by opening at least one end of the housing;

a plurality of contacts arranged in the housing; and

a switching mechanism comprising an actuator member and a shutter member, wherein

said shutter member is pivotally mounted to open and close the card insertion opening between a first position and a second position, the card connector receiving a first card having a first size when the shutter member turns to the first position, and the card connector receiving a second card having a second size when the shutter member turns to the second position.

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ISSUED CLAIMS

Application No. 10/807,312

Patent No. 6,863,571

Attorney Docket No. 04208.0198-00000

Filed March 24, 2004

pushing the movable plate 110 upward by the forward end thereof and creeping under the movable plate 110, and engaged with the second card receiving section 153B of the ejection member 151 to press the ejection member 151. At this time, the ejection member 151 slides so that the end 160 of the cam lever 159 follows the cam groove 156 of the ejection member 151.

Soon, the end 160 of the cam lever 159 reaches the recess 157 of the cam groove 156 and held there, whereby the ejection member 151 is fixed. In this state, the large card B is completely inserted so that the pad sections on the underside of the large card B are firmly brought into contact and connected with the contact sections 106A of the second contact members 106. In such a manner, the large card B is mounted and used for performing the required object.

When the large card B is taken out, the large card B is once slightly pushed as described above to release the latching engagement with ejection mechanism 109, after which the large card B is taken out.

One feature of the composite type card connector 100 of the present invention structured as described above is that the small card A is always guided to be securely held at a regular position.

That is, in the composite type card connector 100 of the present invention described above, the small card A must be always located at the regular position between the lower stepped sections 122 in the card-inserting opening 114 as shown in FIGS. 49 and 50.

However, since the small card A is small in lateral width and thickness, it is liable to be erroneously located at the middle-step position or the upper-step position as shown in FIGS. 51 to 54.

Therefore, the composite type card connector 100 of the present invention is adapted to be properly guided to the regular position even if the small card A is deflected or inclined when inserted.

For example, as shown in FIGS. 51 and 52, when the small card A is inserted to deflect toward the middle-step position of the card-inserting opening 114, the forward end corner of the small card A slides on the upper surface of the elastic member 128 disposed contiguous to the lower stepped section 122, abuts to the slope 132, and is guided inward by the slope 132 to be introduced to the regular position on the inside surface of the lower stepped section 122. When the small card A is further inserted, the forward end corner of the small card A is brought into contact with the first card receiving section 153A of the ejection member 151 to further slide the latter so that the small card A is located at the regular position.

Also, as shown in FIGS. 53 and 54, when the small card is inserted to deflect toward the upper-step position of the card-inserting opening 114, the forward end corner of the small card A slides on the guide slope 130 of the upper surface of the upper stepped section 121, first abuts to the slope 131, and is guided inward. Then, it abuts to the slope 132 to be guided further inward and is introduced to the regular position on the inside surface of the lower stepped section 122. When the small card A is further inserted, the forward end corner of the small card A is brought into contact with the first card receiving section 153A of the ejection member 151 to further slide the latter so that the small card A is located at the regular position.

As described above, even if the small card A is inserted to deflect toward the upper-step position or the middle-step position, the small card A is always guided to the regular position between the lower-stepped sections 122 and 122 by the guide slope 130 and the slopes 131 and 132.

As described, according to the composite type card connector 100 of the present invention, it is possible to use two kinds of cards having different sizes; the small card A and the large card B; without any troubles by a common card connector while necessitating no modification of the cards. Also, according to the present invention, it is possible to form the composite type card connector 100 itself as a case of a flat and thin housing shape, and preferably use it for an information terminal device or an electronic instrument such as a portable telephone, a game machine, a notebook type personal computer, a portable audio set, a television set, a video deck, a digital camera or a music microphone.

Further, since the composite type card connector 100 of the present invention is less in number of movable parts and simple in structure, it is capable of miniaturizing the size and facilitating the replacement.

As described above, according to the composite type card connector of the present invention, it is possible to use two kinds of cards having different sizes; the small card A and the large card B; without any troubles by a common card connector while necessitating no modification of the cards. Also, according to the present invention, it is possible to form the composite type card connector as a case of a flat and thin housing shape, and preferably use it for an information terminal device or an electronic instrument such as a portable telephone, a game machine, a notebook type personal computer, a portable audio set, a television set, a video deck, a digital camera or a music microphone.

The composite type card connector of the present invention may be used for an information terminal device or an electronic instrument such as a portable telephone, a telephone set, a game machine, a notebook type personal computer, a portable audio set, a television set, a video deck, a digital camera or a music microphone.

The present invention has been described in detail with respect to preferred embodiments, and it will now be apparent from the foregoing to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspect, and it is the intention, therefore, in the apparent claims to cover all such changes and modifications as fall within the true spirit of the invention.

What is claimed is:

1. A composite type card connector comprising a connector body having a card-inserting opening, at least one side of which is open, a cover member combined with said connector body, and a plurality of contacts consisting of first contact members for a first card and second contact members for a second card arranged within said connector body, wherein

a switching operation mechanism having a movable plate and an operating plate provided for using said first and second cards which are two kinds of cards of different sizes, such that a card-mounting section in said connector body is switched by said switching operation mechanism.

2. A composite type card connector as defined by claim 1, further comprising an ejection mechanism having an ejection member for discharging said first and/or second card inserted in the card connector and a spring member for elastically deflecting said ejection member, wherein said ejection member is provided with a heart cam having a cam groove on the circumference thereof so that one end of a cam lever pivoted at the other end to said connector body is engaged with said cam groove.

3. A composite type card connector as defined by claim 1, wherein an elastically biased locking mechanism is provided

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for fixing said movable plate of said switching operation mechanism when the first card is inserted.

4. A composite type card connector as defined by claim 3, wherein said movable plate is formed of a plate-like member having left and right side portions bending downward and operates as a guide member movable obliquely upward and downward along a guide groove of said operating plate, said operating plate is adapted to move said movable plate obliquely upward by a guiding member when said second card is inserted.

5. A composite type card connector as defined by claim 3, wherein said locking mechanism comprises a locking arm of a cantilever spring formed at least on one side of said cover member or said operating plate, and a slidable locking member having a projection with which is engaged a front end of said locking arm, and said locking member is movable in association with said movable plate.

6. A composite type card connector as defined by claim 1, wherein stepped sections are disposed in said connector body in correspondence to said cards of different sizes.

7. A composite type card connector as defined by claim 6, wherein said stepped section has an upper stepped section and a lower stepped section.

8. A composite type card connector as defined by claim 7, wherein a guide slope is provided in one of said upper stepped sections, for guiding said first card to a required position.

9. A composite type card connector as defined by claim 1, wherein a cross-section of said card-inserting opening taken in the direction orthogonal to the card-inserting direction is of a flat and provided in a stair-like form on each of opposite sides thereof, a width between both said left and right upper

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stepped sections is larger than that between both said left and right lower stepped sections.

10. A composite type card connector as defined by claim 9, further comprising a card holding mechanism wherein a cantilever-like elastic member projected inward is provided in the vicinity of said card-inserting opening along said lower stepped section, for elastically pressing a lateral side of said first card.

11. A composite type card connector as defined by claim 10, wherein a guide slope is provided in one of said upper stepped sections, for guiding said first card to a required position.

12. A composite type card connector as defined by claim 7, further comprising a card holding mechanism wherein a cantilever-like elastic member projected inward is provided in the vicinity of said card-inserting opening along said lower stepped section, for elastically pressing a lateral side of said first card.

13. A composite type card connector as defined by claim 12, wherein said elastic member is a spring member of metallic material molded or press-fit into said connector body.

14. A composite type card connector as defined by claim 12, wherein said elastic member is a spring member of synthetic resinous material molded integral with said connector body.

15. A composite type card connector as defined by claim 14, wherein said spring member of synthetic resinous material is different in height between left and right ones.

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PENDING CLAIMS
Application No. 10/972,653
Attorney Docket No. 04208.0208-00000
Filed October 26, 2004

1. An IC card-connecting adapter for allowing an electronic apparatus having a card connector sized to accept a first IC card to accept a second, dimensionally different IC card, comprising:

a housing member configured to detachably accommodate said second IC card, and

a connecting section provided at one end of said housing member, wherein

said connecting section includes at least one contact terminal having a pad portion at one end thereof and a contact portion formed as one piece with said pad portion at the other end thereof;

said pad portion is formed and positioned in said connecting section to be electrically connected to said card connector of said electronic apparatus when said adapter is initiated into said electronic apparatus; and

said contact portion is formed to physically and electrically accept said second IC card.

2. An IC card-connecting adapter as claimed in claim 1, wherein said contact terminal is one of a plurality of contact terminals provided in correspondence to the respective electrodes of said second IC card, and at least one of said contact terminals is provided with a ground contact portion to be electrically connected to said housing member in an intermediate area between said contact portion and said pad portion.

3. An IC card-connecting adapter as claimed in claim 1, wherein said connecting section has a support section for supporting said contact terminal and a groove into which said pad section of said contact terminal is inserted.

4. An IC card-connecting adapter as claimed in claim 2, wherein said ground contact portion is brought into contact with a ground piece provided integral with an end of said housing member.

5. An IC card-connecting adapter as claimed in claim 1, wherein said housing member has a resiliently deformable contact piece brought into contact with a portion of said contact terminal between said contact portion and said pad portion.

6. An IC card-connecting adapter as claimed in claim 2, wherein said contact terminal having said ground contact portion is arranged at an end of the arrangement of said contact terminals.

7. (Cancelled)

PENDING CLAIMS
Application No. 11/038,274
Attorney Docket No. 04208.0212-00000
Filed January 21, 2005

1. A card connector for an electronic device to which one of a plurality of IC cards having the same pad pitch can be selectively attached, comprising:

a space configured to receive one of a first IC card and a second different dimensional IC card; and

a plurality of contacts provided in the space, said contacts being substantially parallel to the direction along which the first and second IC cards are inserted,

wherein at least one of the contacts provided in the space has first and second contact points in a front-and-rear relationship along the direction along which the IC card is inserted, the first contact point contacts a first pad on the first IC card when the first IC card is inserted, and the second contact point contacts a second pad on the second IC card when the second IC card is inserted.

2. The card connector for the electronic device as claimed in claim 1, further comprising:

a guide mechanism for identifying which of said first and second IC cards is being inserted; and

an actuator for guiding inserted IC cards based on the result of the identification by the guide mechanism, wherein, when the first IC card is inserted, the actuator guides the first IC card to a position where the first contact point contacts the first pad and, when the second IC card is inserted, the actuator guides the second IC card to a position where the second contact point contacts the second pad .

3. The card connector for the electronic device as claimed in claim 1, wherein:

said first contact point extends via an elastic portion formed by partially cutting and elevating a portion of said contact.

4. The card connector for the electronic device as claimed in claim 3, wherein

said contact is further provided with holes between said first and second contact points.

5. The card connector for the electronic device as claimed in claim 3, wherein
said first and second contact points are on elastic portions of said contact that
extend in different directions along said contact.

6. The card connector for the electronic device as claimed in claim 3, wherein
said first and second contact points are on elastic portions of said contact that
extend in the same direction along said contact.

7. The card connector for the electronic device as claimed in claim 3, wherein
at least one of said first and second contact points is partially cut and elevated to
form an elastic portion that extends in the direction along which the IC card is inserted.

8. The card connector for the electronic device as claimed in claim 3, wherein
said first and second contact points have different heights.

9. A contact for attachment to a card connector for an electronic device to which
one of a plurality of IC cards having the same pad pitch can be selectively attached,
comprising:

first and second contact points provided along said contact in a front-and-rear
relationship along the direction along which the card is inserted.

10. The card connector for the electronic device as claimed in claim 1, further
comprising:

a spring-loaded gate dimensioned to permit passage of said first IC card and
prevent passage of said second IC card; and

a guide mechanism dimensioned to detect insertion of said second IC card and
coupled to permit pivoting of said gate upon detection of said second IC card to permit
passage of said second IC card into said space.